

# The Impacts of the Atlantic Multidecadal Variability on Tropical Pacific

(as Assessed from CMIP6/DCPP-C Idealized Simulations)

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AGU General Assembly 2019, San Francisco



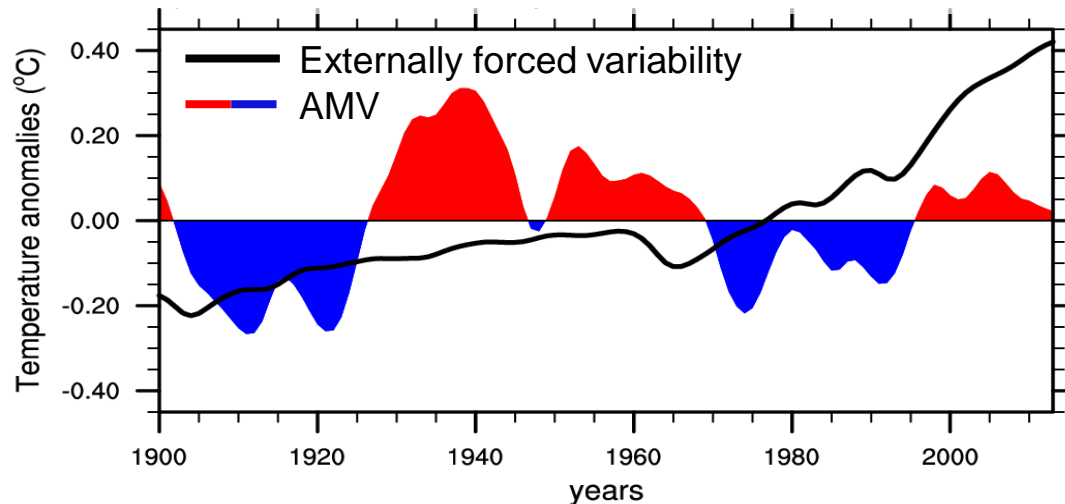
INADEC: H2020-MSCA-800154



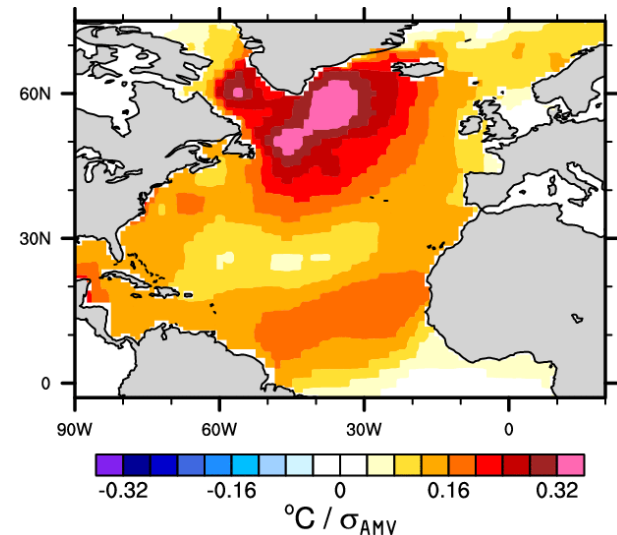
# The AMV

## Atlantic Multidecadal Variability (AMV)

North Atlantic SST time series (Ting et al. 2009)



AMV pattern

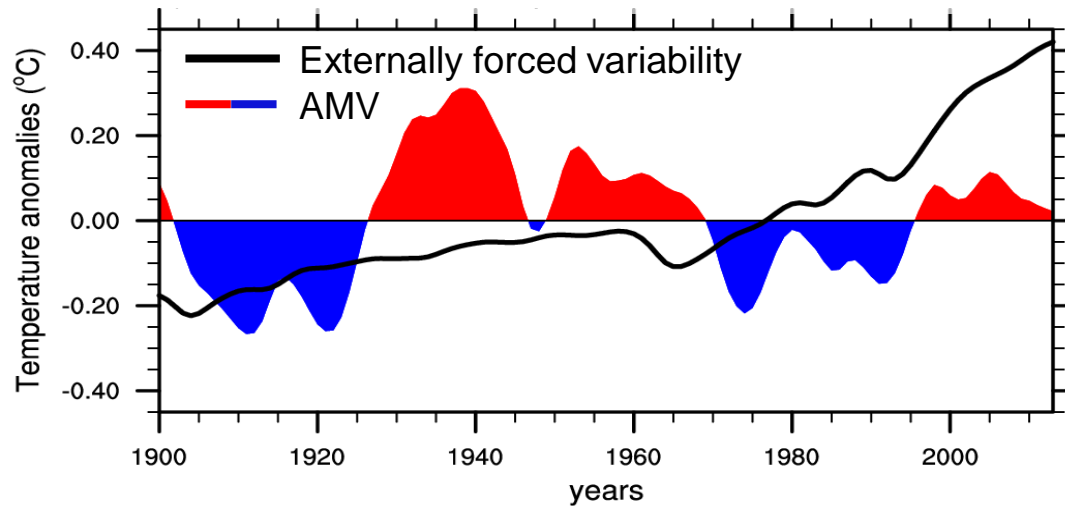


- Droughts over N. and S. America
- European summer temperature
- Sahel drought
- Arctic sea-ice
- Occurrence of weather extremes
- Tropical cyclone activity
- Hiatus

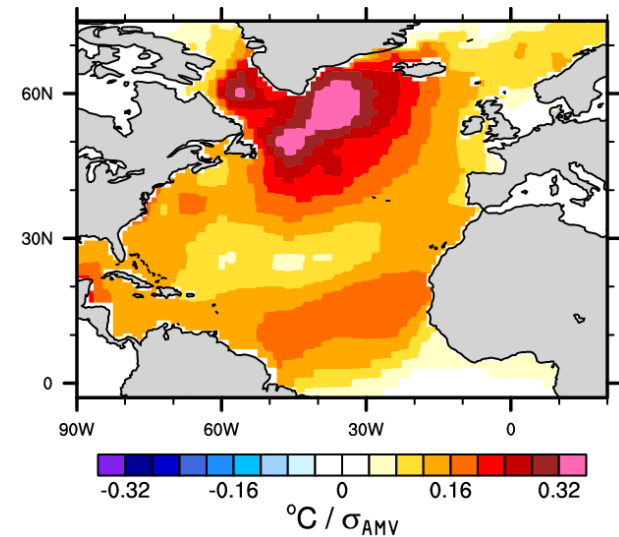
# Linked between AMV and tropical Pacific

## Atlantic Multidecadal Variability (AMV)

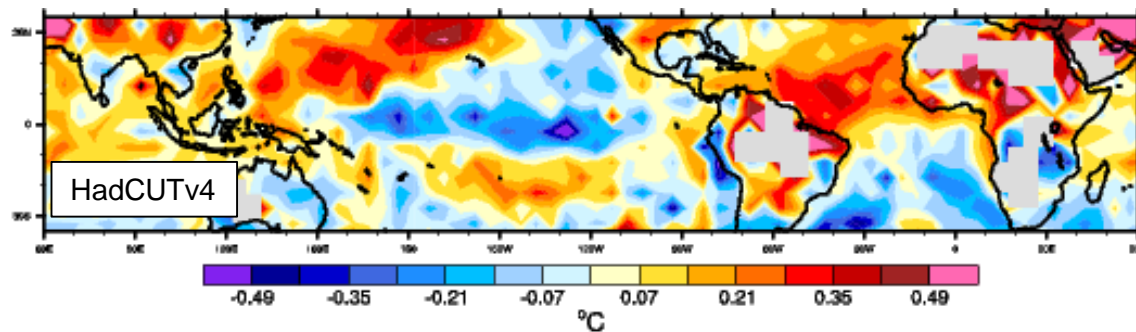
North Atlantic SST time series (Ting et al. 2009)



AMV pattern



Observed AMV composites: DJFM



# This study:

**Proposal:** North Atlantic warming drives a La-Niña-like response

**Questions:** Do models confirm such link? How strong the tropical Pacific response?

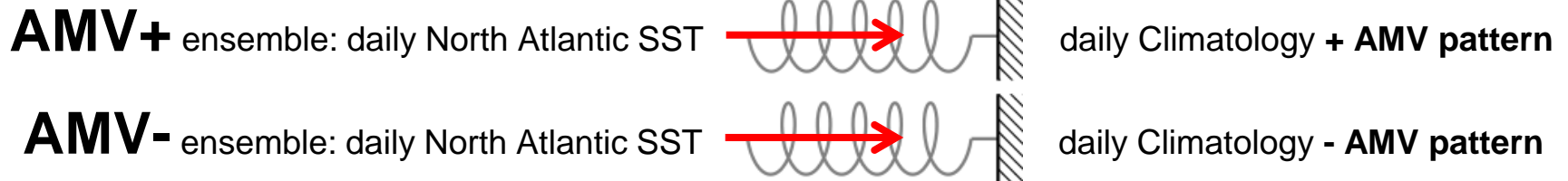
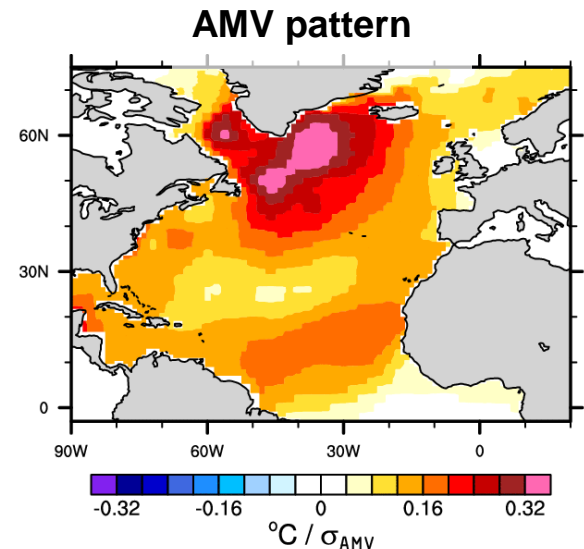
**Method:** evaluate Tropical Pacific response in idealized AMV simulations

# The idealized AMV Experiments

North Atlantic SSTs (5°N-70°N) restored to the **observed AMV pattern** with a 5/15-day restoring time scale

**10yr long large ensemble** experiments

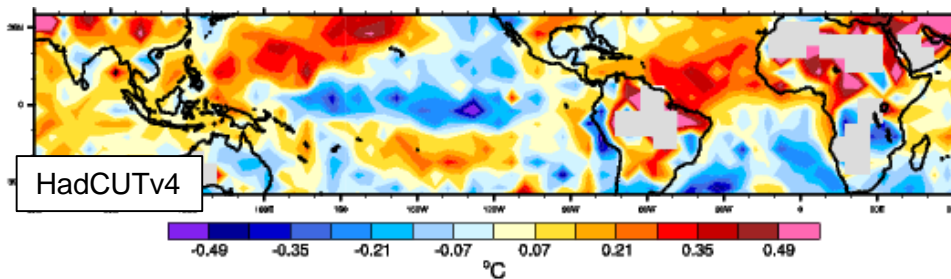
**Free ocean-ice-land-atmosphere interactions** outside the Atlantic



- 1xAMV forcing (10)
- 2xAMV forcing (9)
- 3xAMV forcing (3)
- 2xAMV forcing with SLAB ocean (2)
- **Total of 24 sets of simulations**

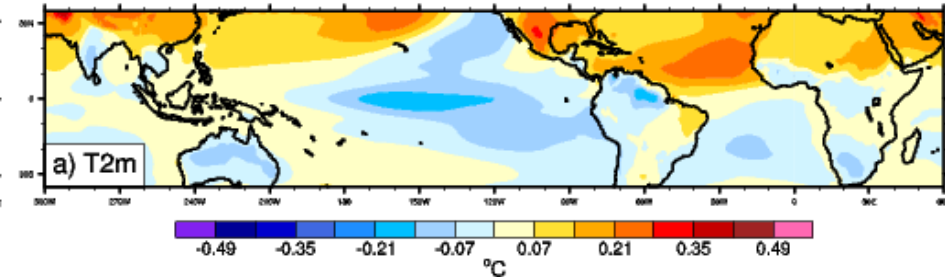
# Multi-Model Mean - DJFM

Observed AMV composites: DJFM



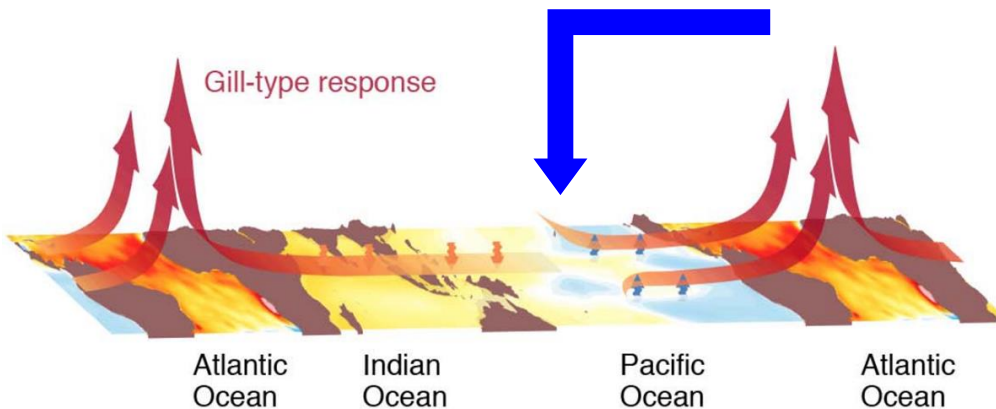
MMM AMV+ - AMV-: DJFM

(10yr averaged ensemble mean)

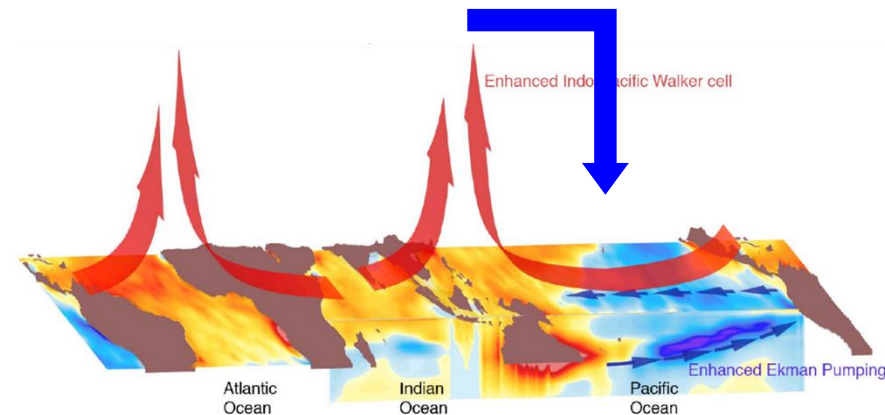


- Li et al. (2016) explain such link:

## Phase-1: Atlantic forcing

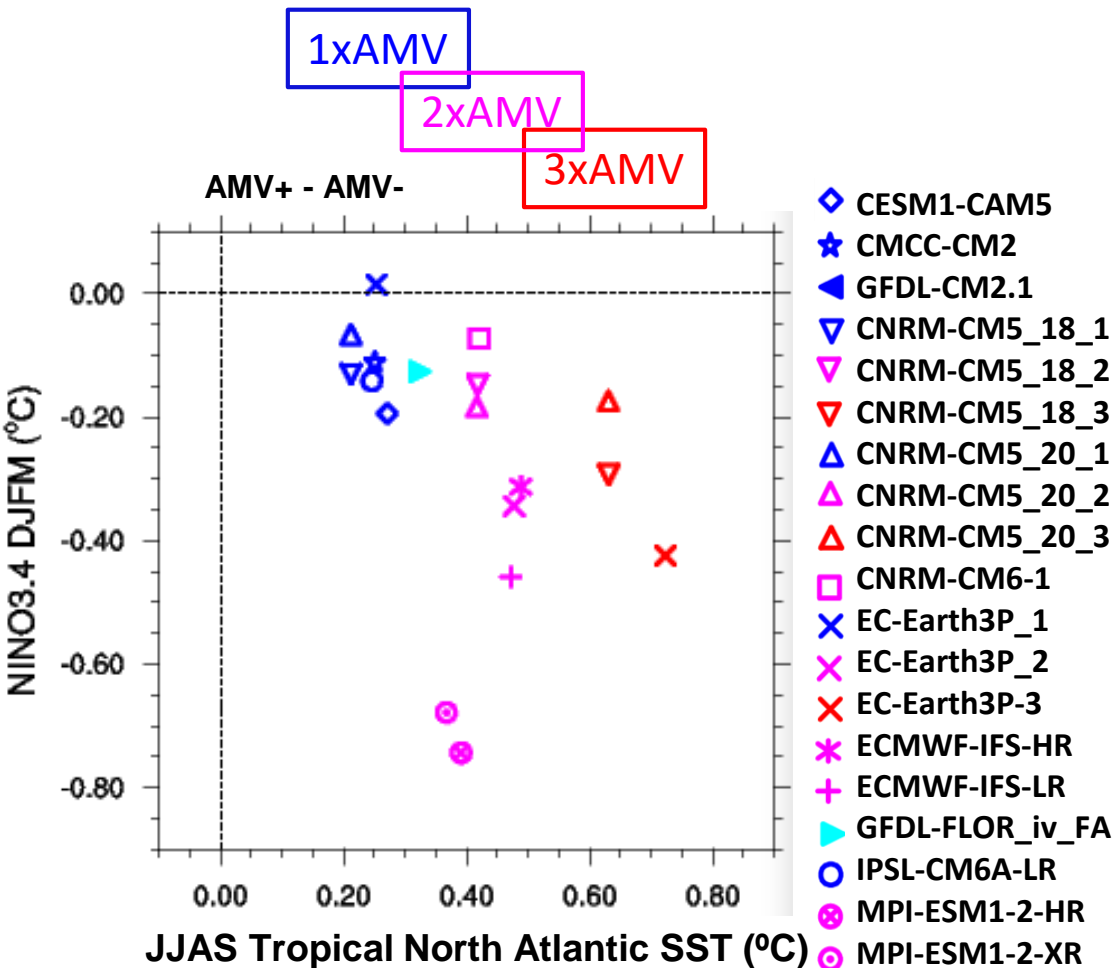


## Phase-2: Indo-Pacific feedback

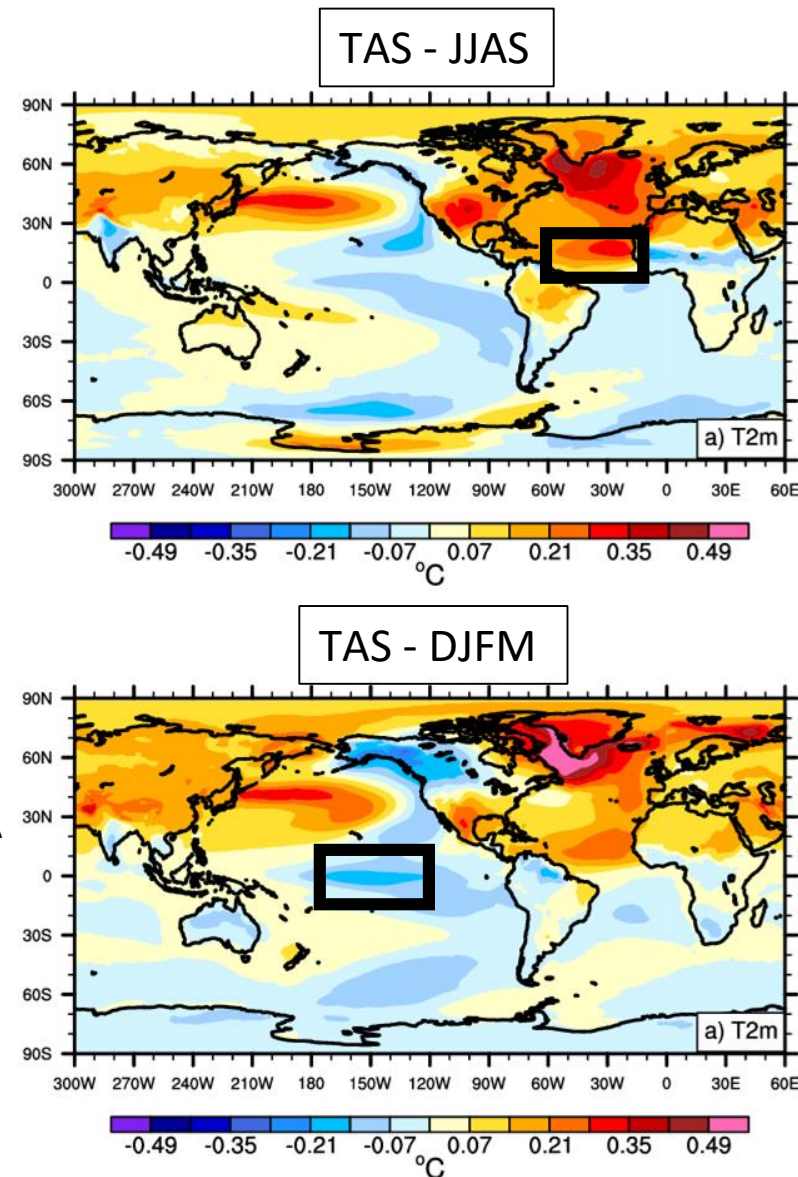




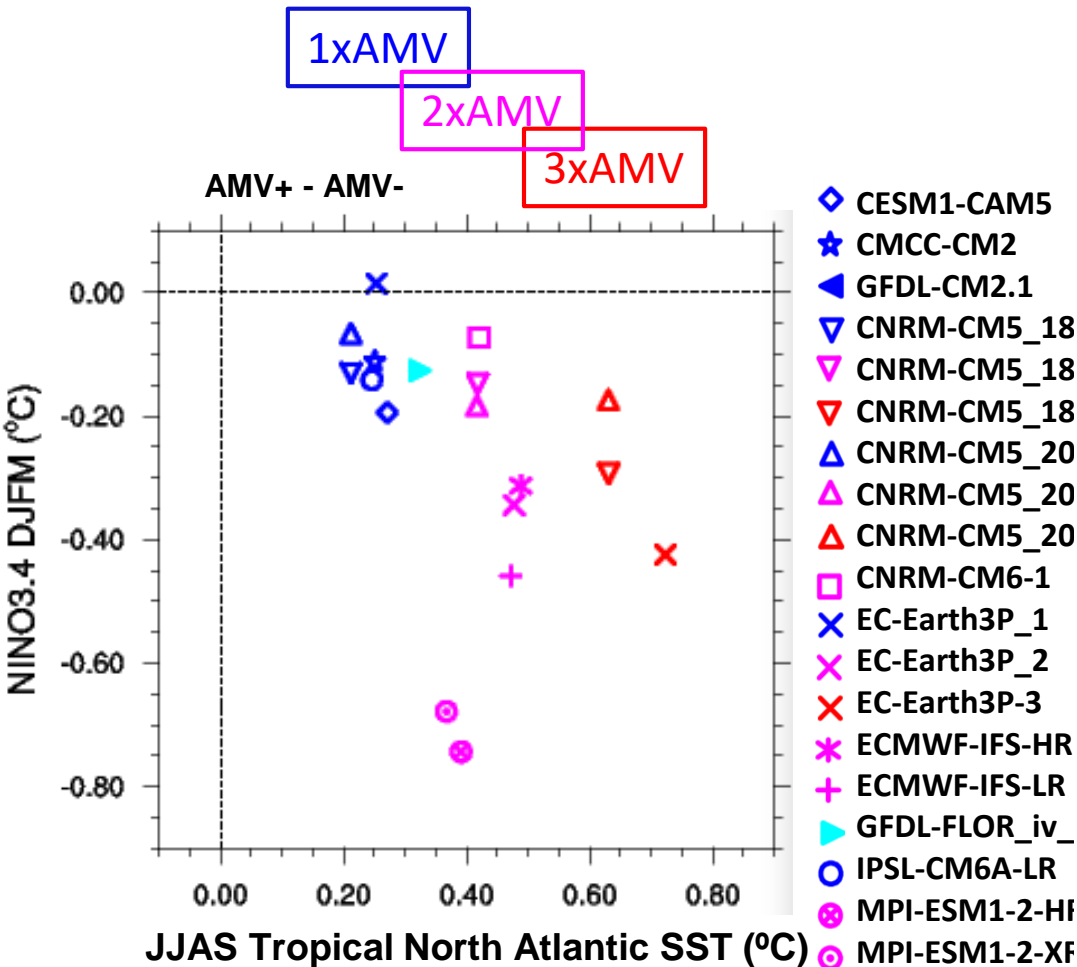
# Multi Model Mean response vs Individual Model response



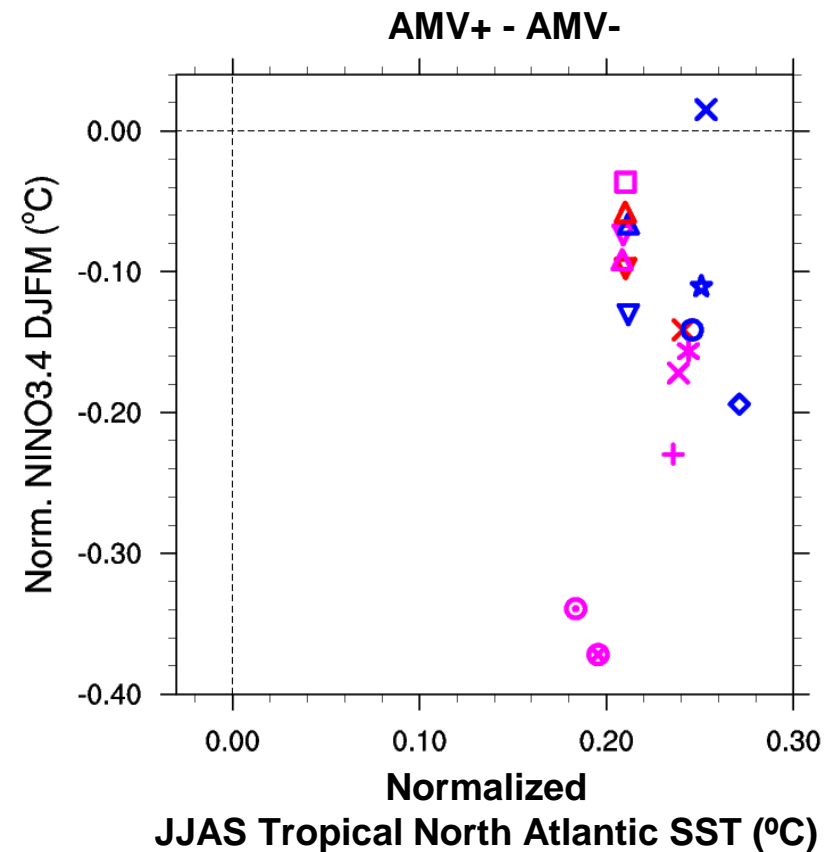
Very large ensemble-spread in NINO3.4 response for same Tropical NASST forcing



# Multi Model Mean response vs Individual Model response



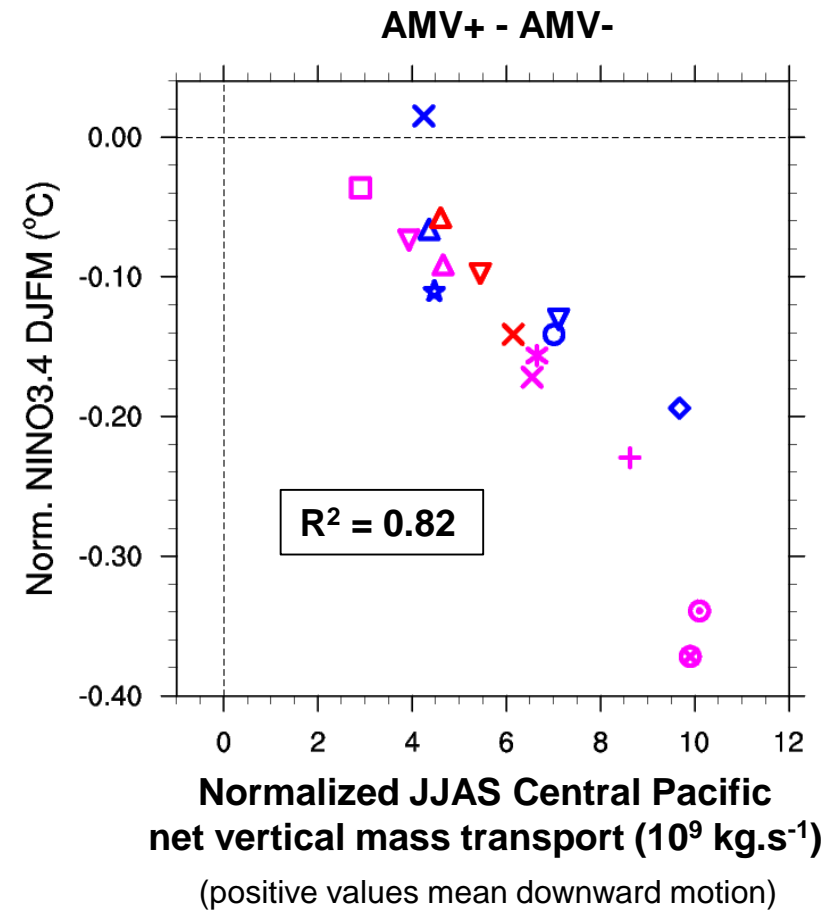
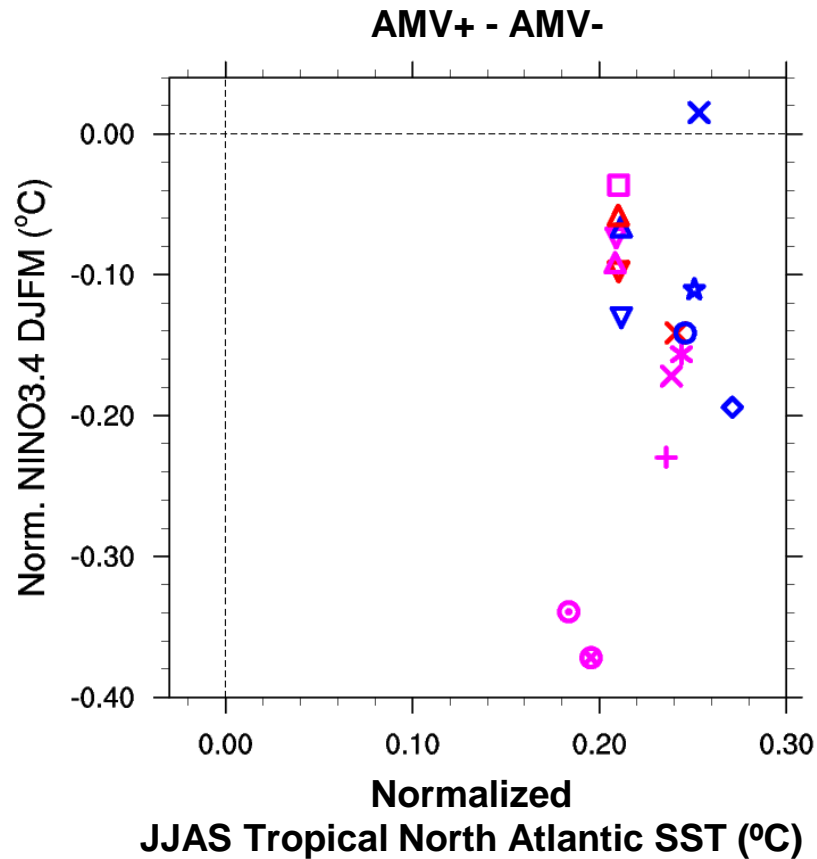
Very large ensemble-spread in NINO3.4 response for same Tropical NASST forcing



Factor 5-10 in the response amplitude



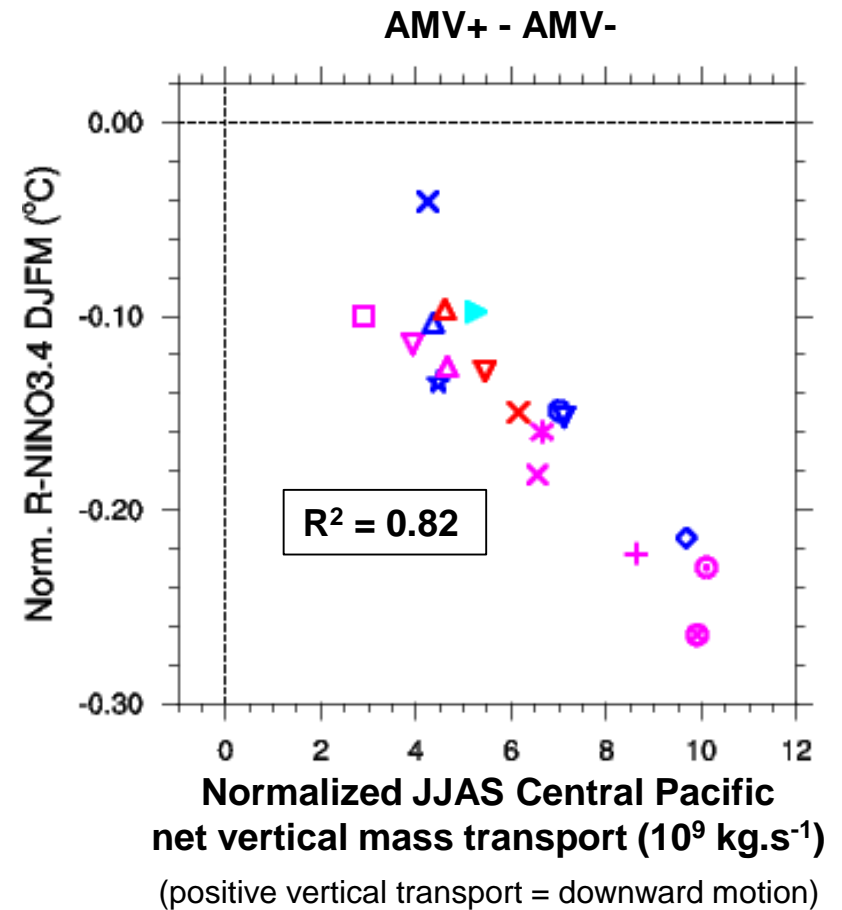
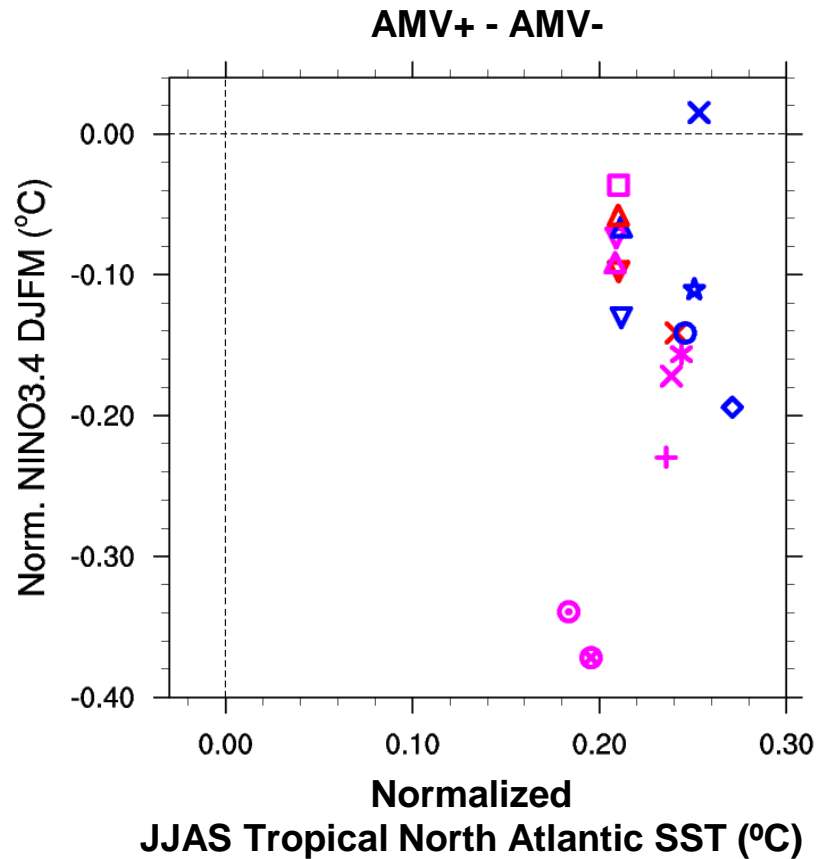
## Origins of NINO3.4 inter-model spread?



- 1) JJAS Central Pacific response explained 82% of DJFM NINO3.4 inter-model spread

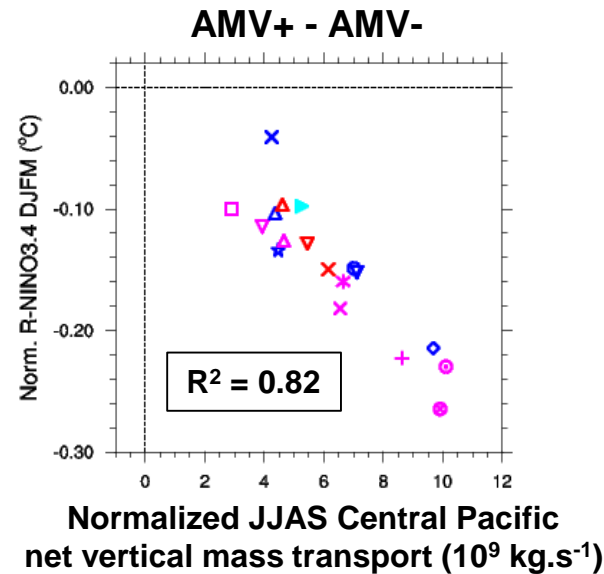
(positive vertical transport = downward motion)

# Origins of NINO3.4 inter-model spread?

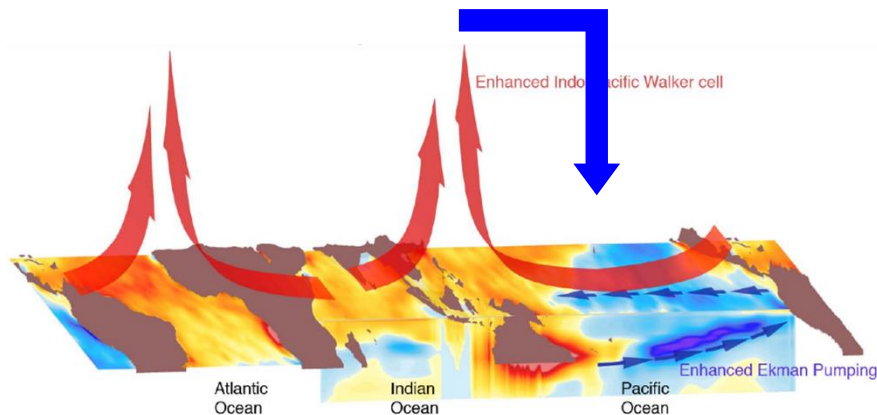


- 1) JJAS Central Pacific response explained 82% of DJFM NINO3.4 inter-model spread
- 2) Tropical Pacific dynamics is better capture using relative NINO3.4 index: R-NINO3.4

# Origins of Central Pacific subsidence inter-model spread?

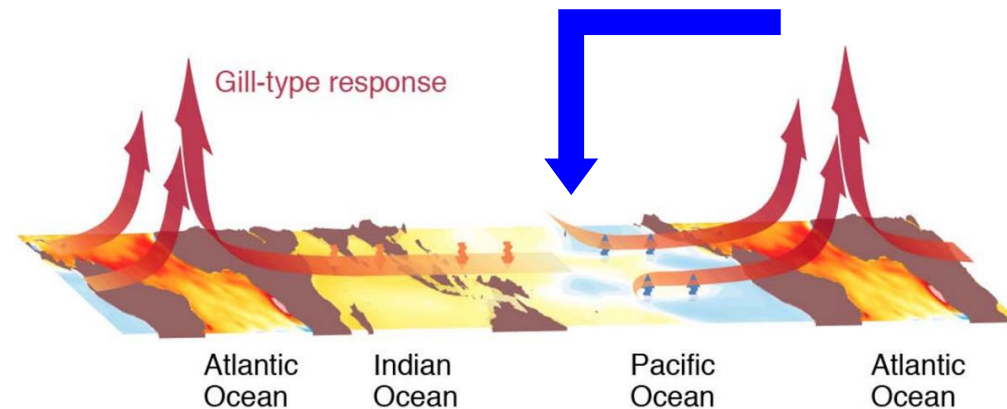


## Phase-2: Indo-Pacific feedback



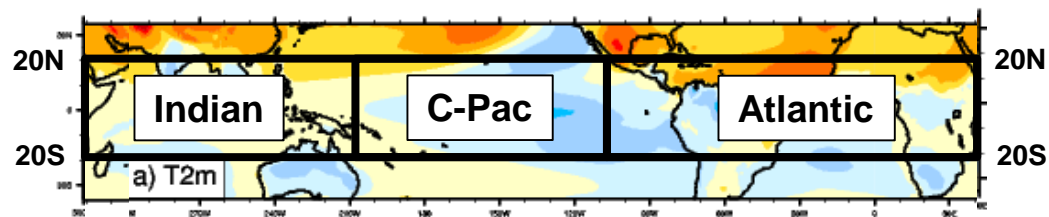
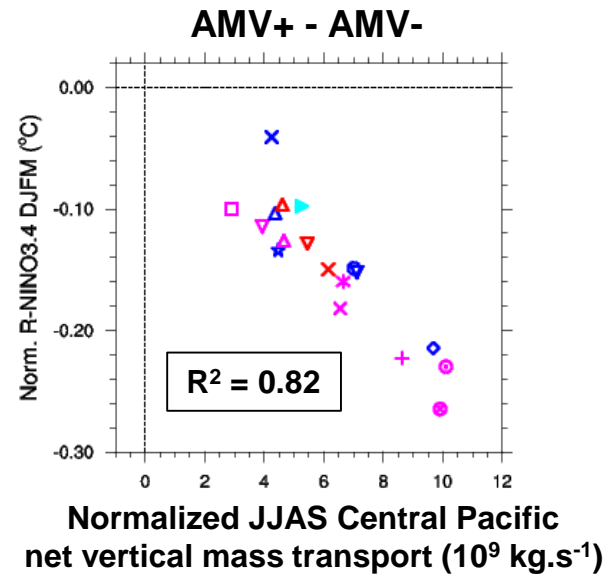
Relative SST = SST – mean Tropical SST

## Phase-1: Atlantic forcing

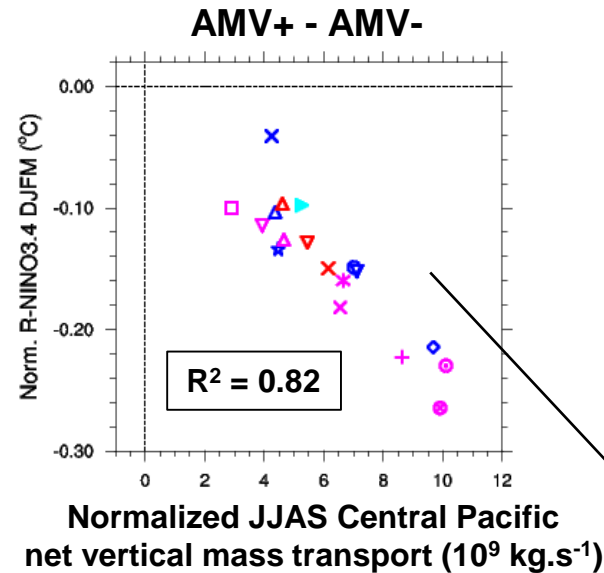


(positive vertical transport = downward motion)

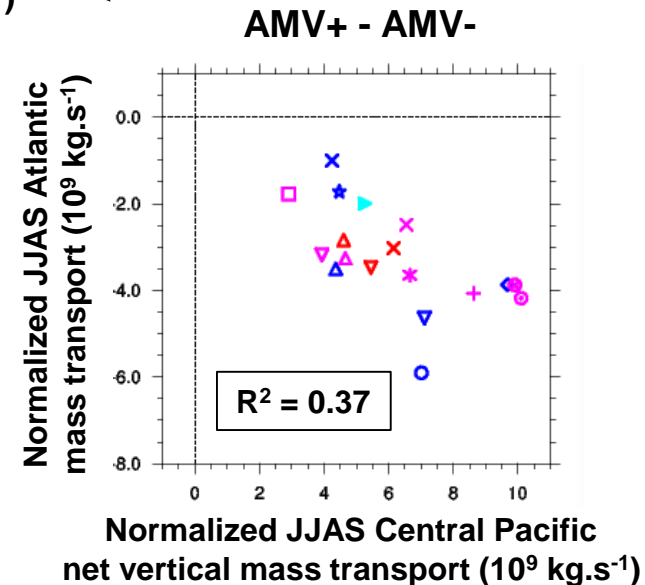
# Origins of Central Pacific inter-model spread?



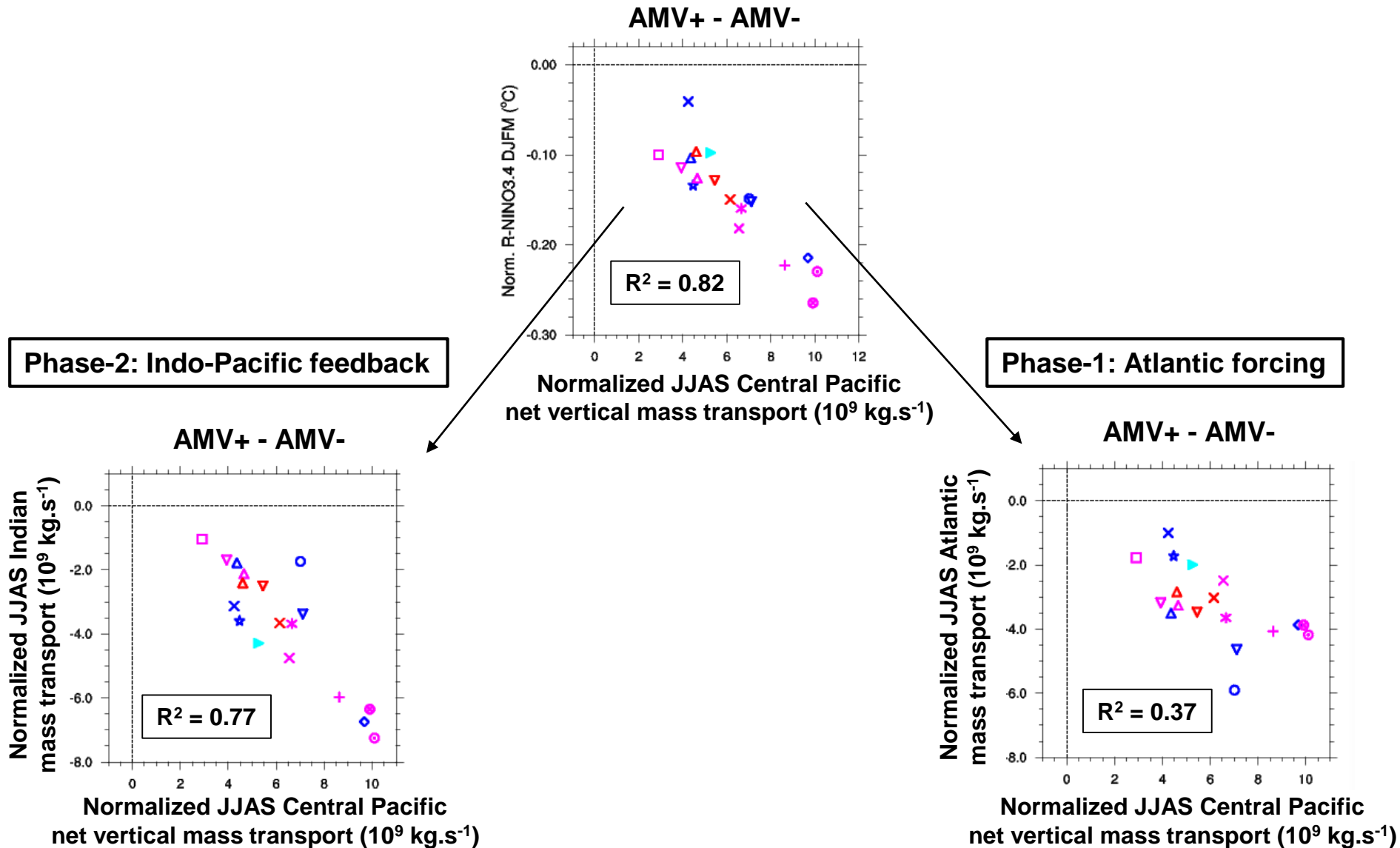
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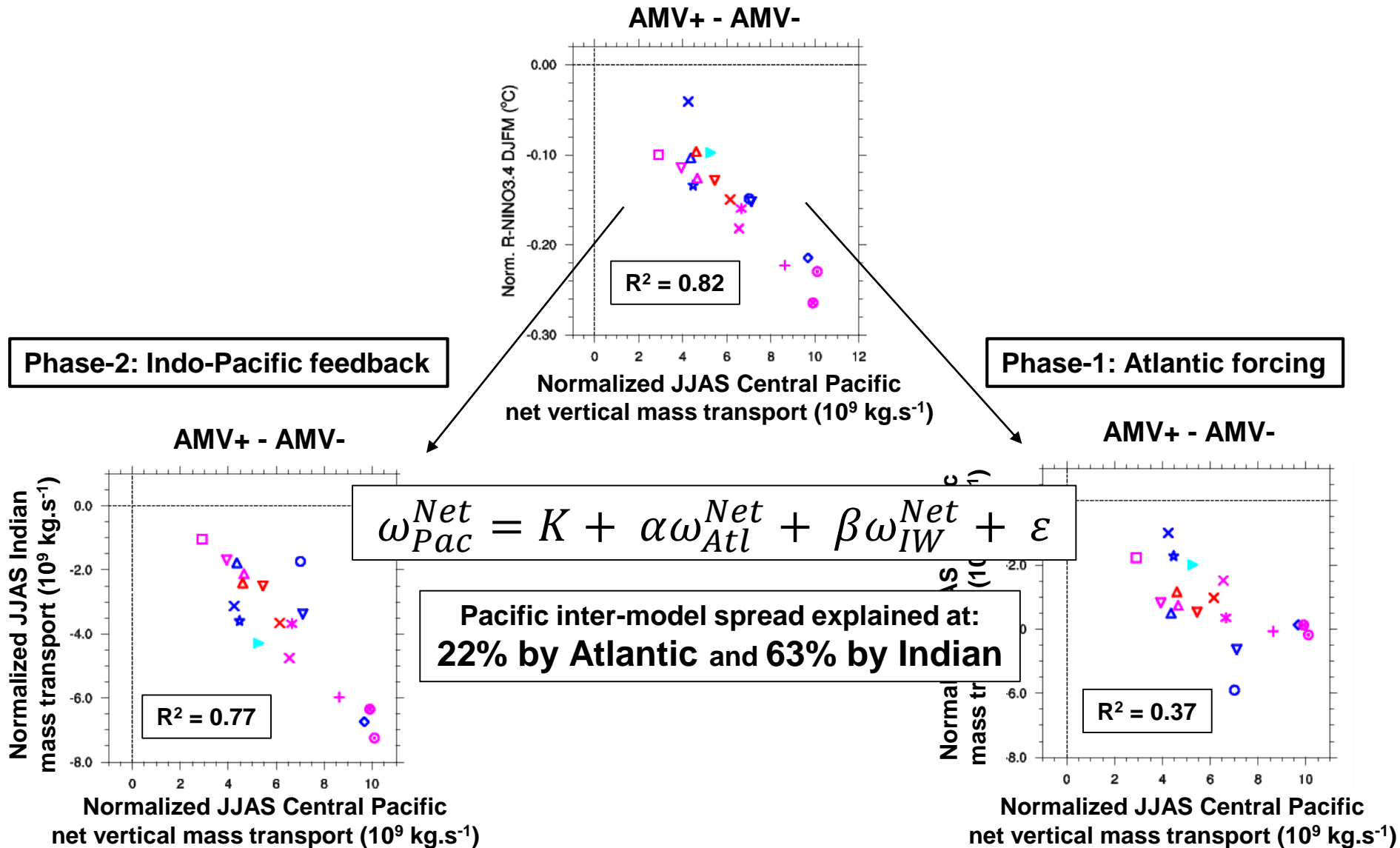
Phase-1: Atlantic forcing



# Origins of Central Pacific inter-model spread?

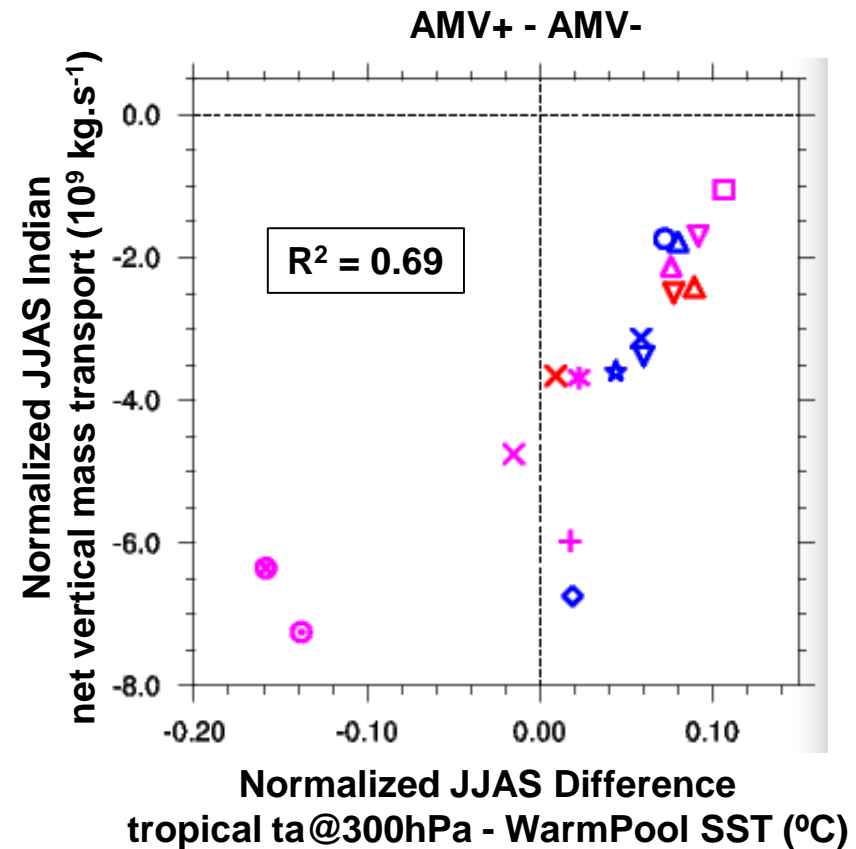
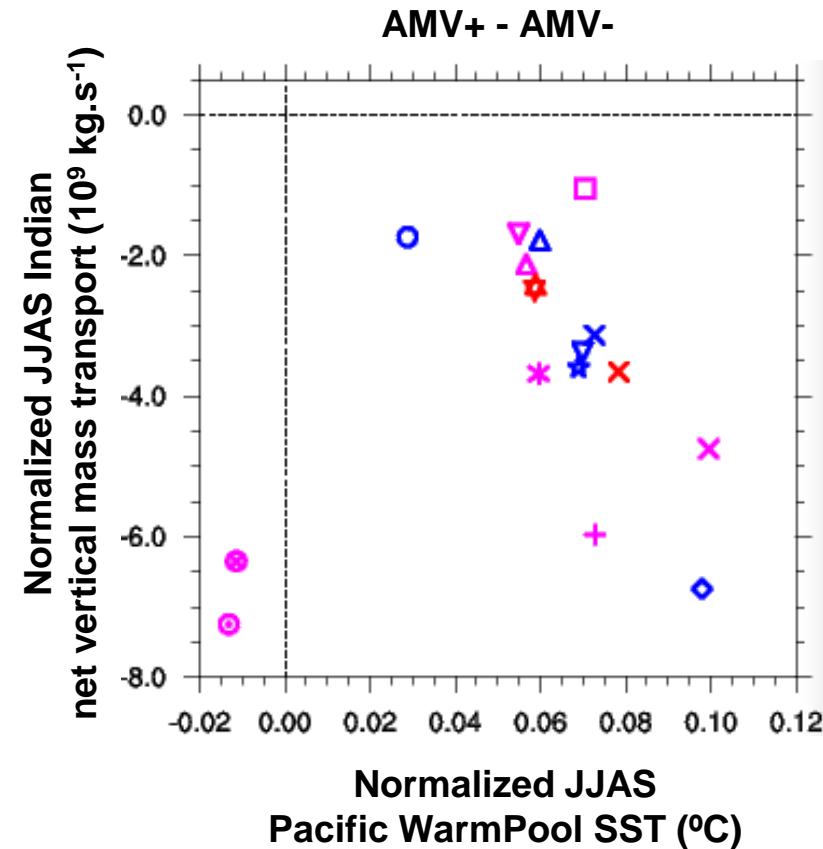


# Origins of Central Pacific inter-model spread?



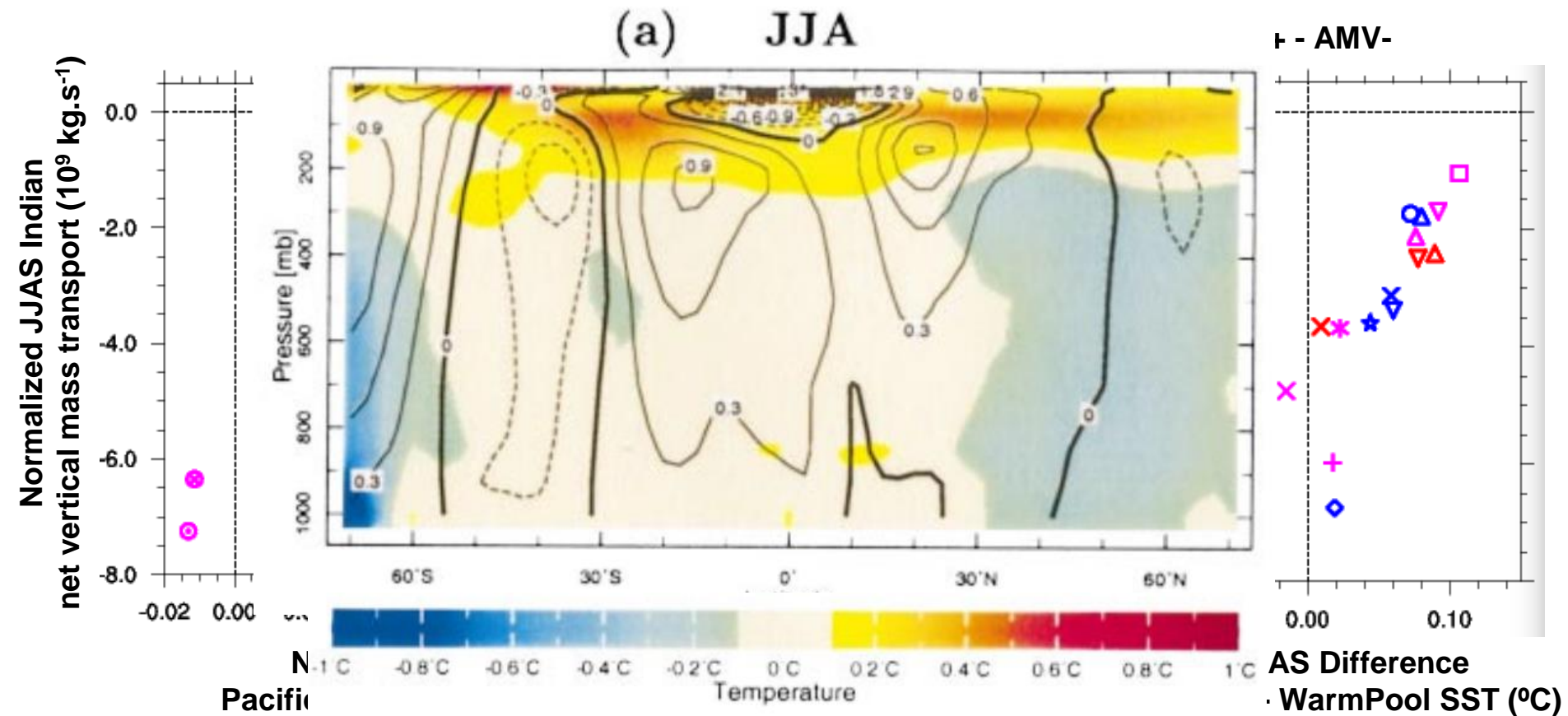


# Origins of Indian ascent inter-model spread?



**Indian ascent proportional to atmospheric stability over Pacific WarmPool**

# Origins of Indian ascent inter-model spread?



Observed zonal mean temperature regression on ENSO

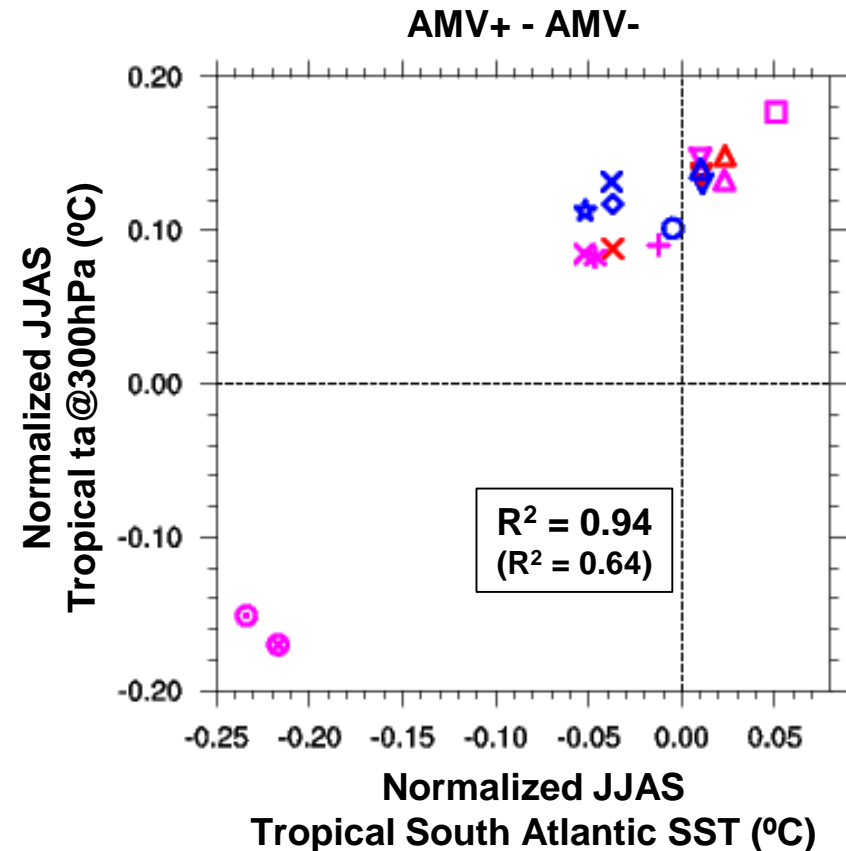
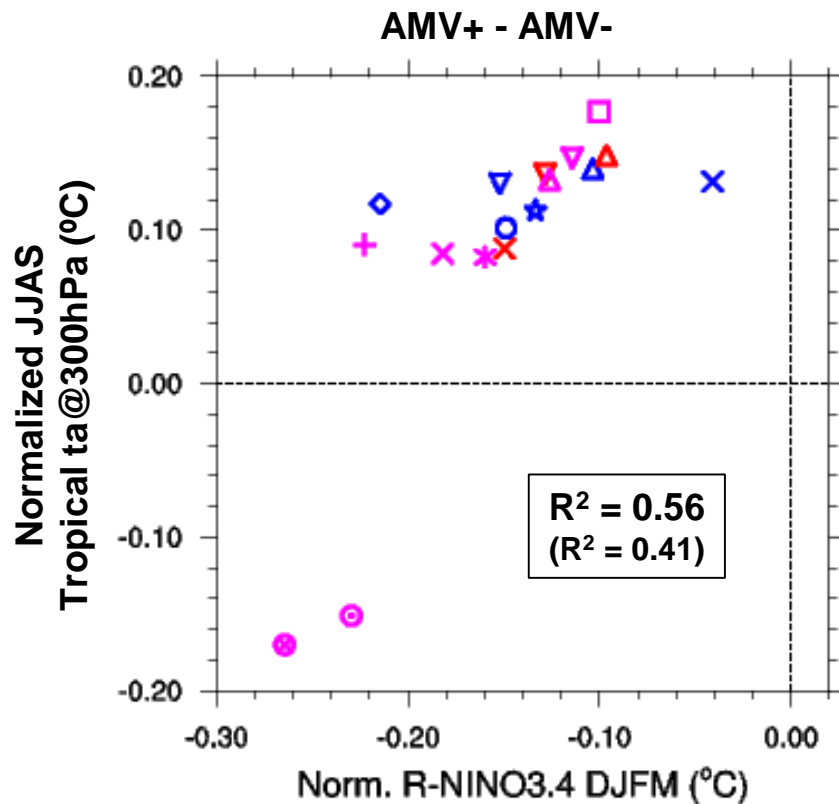
credits: Seager et al. (2003)

**Indian ascent proportional to atmospheric stability over Pacific WarmPool**

Relative SST = SST – mean Tropical SST

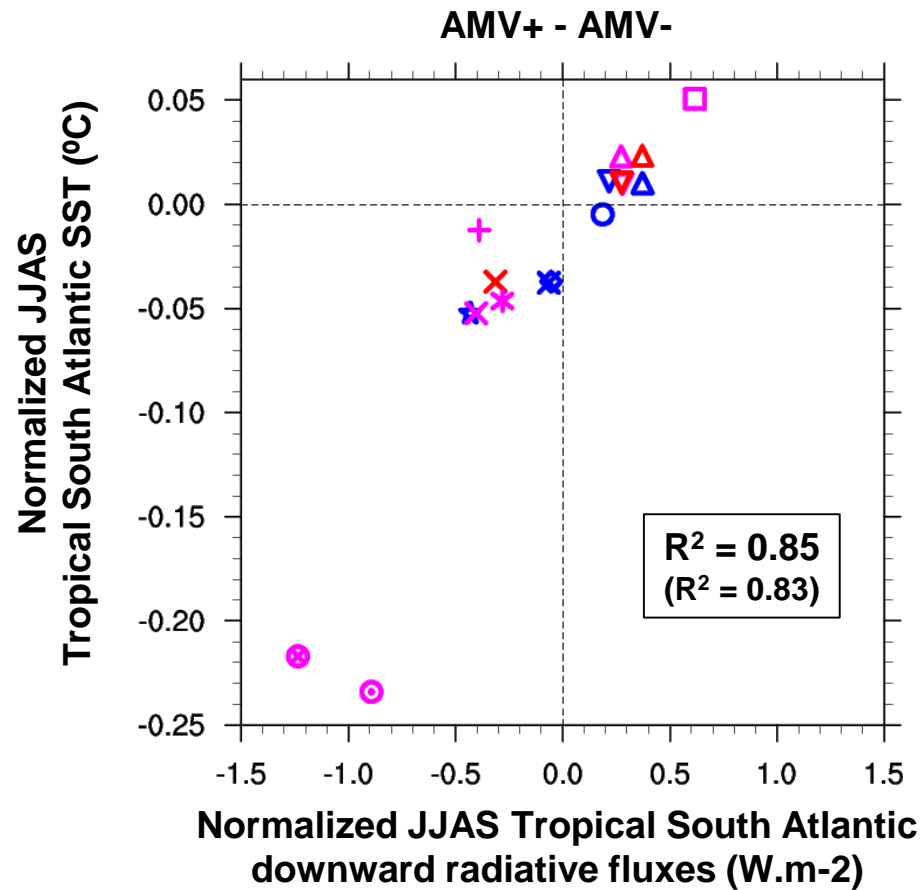
(positive vertical transport = downward motion)

# Origins of Indian ascent inter-model spread?



**Tropical South Atlantic SST appears to control upper troposphere tropical temperature (radiative cooling?) and WarmPool convection inter-model spread**

# Origins of tropical South Atlantic inter-model spread?

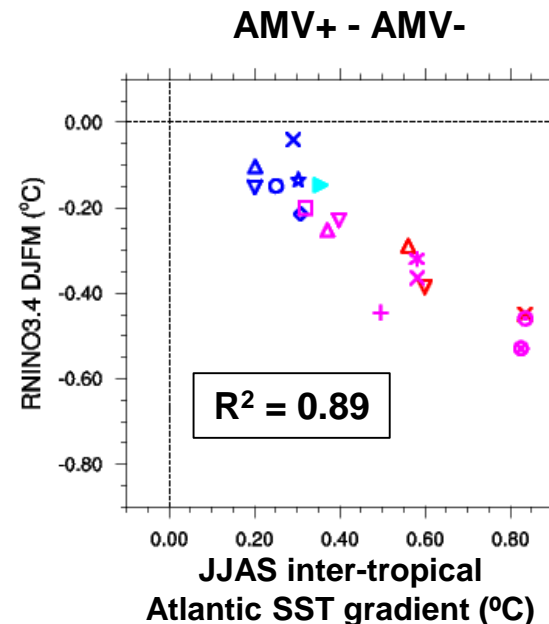
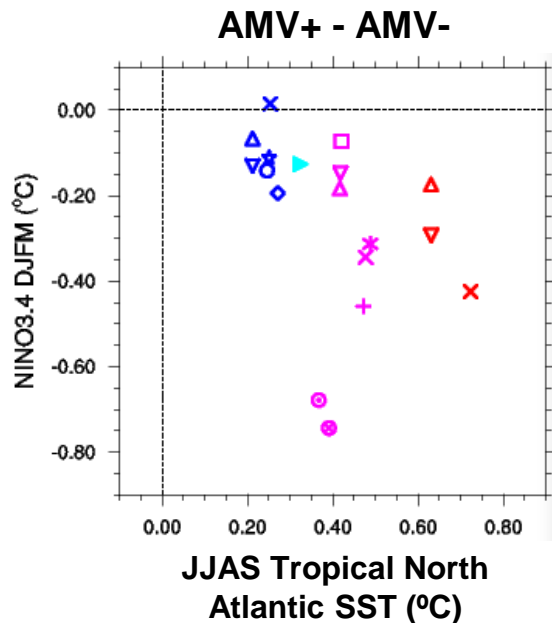


**Tropical South Atlantic SST controlled by radiative downward fluxes**  
**Probably due to different SST / low cloud relationship**

# Summary

According to idealized AMV experiments, AMV warming drives trop. Pacific cooling

- But factor 10 among models
- Mostly explained by Indo-Pacific feedback spread
- Linked to tropical South Atlantic cooling spread
- Potentially linked to SST / low cloud representation



**Thank you!**